

WHAT IS CLAIMED IS:

- 1 1. A magnetic sensor comprising a tunneling magnetoresistive stack, wherein the stack
2 comprises a free layer comprising a synthetic antiferromagnet (SAF).
- 1 2. The sensor of claim 1, wherein the SAF comprises a first ferromagnetic layer, a second
2 ferromagnetic layer, and a spacer layer between the first and second ferromagnetic layers,
3 wherein the first and second ferromagnetic layers have anti-parallel magnetic moments.
- 1 3. The sensor of claim 2, wherein the first and second ferromagnetic layers comprise a
2 ferromagnetic material selected from the group consisting of CoFe and NiFe, and the
3 spacer layer comprises a material selected from the group consisting of Ru and Cu.
- 1 4. The sensor of claim 1, wherein the magnetoresistive stack further comprises a barrier
2 layer on the free layer and a pinned layer on the barrier layer, and wherein the pinned
3 layer comprises a synthetic antiferromagnet (SAF).
- 1 5. The sensor of claim 4, wherein the stack further comprises a bias layer on the free layer
2 opposite the barrier layer, wherein the bias layer comprises an antiferromagnetic material.
- 1 6. The sensor of claim 5, wherein the antiferromagnetic material is selected from the group
2 consisting of IrMn, PtMn, NiMn, RhMn, and RuRhMn.
- 1 7. The sensor of claim 5, further comprising a second spacer layer and a ferromagnetic layer
2 between the bias layer and the free layer.
- 1 8. The sensor of claim 7, wherein the spacer layer is made from a material selected from the
2 group consisting of Cu and Ru.
- 1 9. A magnetic read/write head comprising a tunneling magnetoresistive stack capable of
2 operating in a mode wherein a sense current is applied to the stack in a direction normal
3 to a plane of the stack, wherein the head comprises the following layers, in order:
4 (a) a bias layer comprising an antiferromagnetic material,
5 (b) a free layer comprising a synthetic antiferromagnet (SAF), wherein the SAF
6 comprises a first ferromagnetic layer, a second ferromagnetic layer, and a spacer layer

7 between the first and second ferromagnetic layers, wherein the first and second
8 ferromagnetic layers have anti-parallel magnetic moments,

9 (c) a barrier layer;

10 (d) a pinned layer comprising an antiferromagnetic material; and

11 (e) a pinning layer comprising an antiferromagnetic material.

1 10. The read/write head of claim 9, wherein the pinned layer is a synthetic antiferromagnet
2 (SAF)

1 11. The read/write head of claim 9, wherein the first ferromagnetic layer has a thickness T_1 ,
2 the second ferromagnetic layer has a thickness T_2 , and T_1 is not equal to T_2 .

1 12. The read/write head of claim 9, further comprising a second spacer layer and a
2 ferromagnetic layer between the bias layer and the free layer.

1 13. The read/write head of claim 9, wherein the first and second ferromagnetic layers
2 comprise a ferromagnetic material selected from the group consisting of CoFe and NiFe,
3 and the spacer layer comprises a material selected from the group consisting of Ru and
4 Cu.

1 14. The read/write head of claim 13, wherein the spacer layer is Ru.

1 15. A method for increasing the sensitivity of a magnetic read/write head, wherein the
2 read/write head comprises a tunneling magnetoresistive stack capable of operating in a
3 mode wherein a sense current is applied to the stack in a direction normal to a plane of
4 the stack, the method comprising incorporating into the stack a free layer comprising a
5 synthetic antiferromagnet (SAF), wherein the SAF comprises a first ferromagnetic layer,
6 a second ferromagnetic layer, and a spacer layer between the first and second
7 ferromagnetic layers, and wherein the first and second ferromagnetic layers have anti-
8 parallel magnetic moments.

1 16. The method of claim 15, wherein the first and second ferromagnetic layers comprise a
2 ferromagnetic material selected from the group consisting of CoFe and NiFe, and the
3 spacer layer comprises a material selected from the group consisting of Ru and Cu.

1 17. A hard disc drive comprising a magnetic read/write head of claim 9.

1 18. A computer comprising the read/write head of claim 9.

19. A magnetic storage device comprising the read/write head of claim 9.

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